AVON
CHARTER TOWNSHIP
1275 W. AVON RD., ROCHESTER, MICH. 48063

February 1, 1984

United States
Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604

Attn: James A. Knoy, Environmental Scientist

Dear Mr. Knoy:

Since our last correspondence, I have been able to locate a copy of the Keck Report. I thought it might be of some use to you.

If I can be of any further assistance to you, please do not hesitate to contact me.

Sincerely,

BUILDING DEPARTMENT

Jerome J. Eby
Housing & Zoning Official

JJE/jm

Enc.

KECK CONSULTING SERVICES, INC.
4903 Dawn Avenue • East Lansing, Michigan 48823 • (517) 332-8623

January 22, 1976

Mr. Almon J. Durkee, Director
Bureau of Facilities
Department of Management and Budget
Stevens T. Mason Building
Lansing, Michigan 48913

Ground Water Contamination Study
Avon Township, Oakland County,
Michigan

Exhibits:
(a) Topographic Map of Study Area showing Surface Water Quality Sampling Locations.
(b) Site Map showing Monitor Well Locations.
(c) Columnar Sections of Auger Borings and Monitor Well Design.
(d) Ground Water Table Elevation Contour Map.
(e) Map showing Chemical Concentrations in Samples from Monitor Wells.

Appendicies:
1.) Auger Boring Logs
2.) Water Quality Analyses

Ground Water Contamination Study
Avon Township, Oakland County, Michigan

Introduction

Numerous domestic wells in Avon Township, Oakland County, Michigan have become polluted. Specifically, these wells are located in the NW$\frac{1}{4}$, SE$\frac{1}{4}$, Section 24, T.3N., R.11E., Avon Township. Due to the contamination, the wells can no longer be used for domestic supply. In an effort to delineate the source(s) of contamination, the State of Michigan, Department of Management and Budget has retained Keck Consulting Services, Inc., to study the problem. The study has been completed and is presented in the following report along with the conclusions and recommendations.

Background

The contaminated wells referred to in the introduction are in an area enclosed by three sanitary landfill operations. These are located on the map in Exhibit (a). Two of the three landfills, Southeast Oakland County Incinerator Authority and Sandfill Incorporated are currently active. The Stan's (J. Fons) Landfill has been closed since June 2, 1975, by order of the Department of Natural Resources, Solid Waste Management Division. A fourth landfill operated by Hamlin Development and located in Sections 19 and 30, Macomb County, has been indicated as a possible source of the pollution. The three previously referred to landfills have also come under suspect, perhaps to a greater degree due to their proximity to the contaminated wells.

According to the information available, the Stan's Landfill was formerly a sand and gravel pit operated by the Walker Sand and Gravel Company. Actually, the Stan's Trucking Sanitary Landfill is now operated by the J. Fons Company. Filling operations began in mid-1970 in the southeast portion of the property. The northeast area became active in 1972 and was filled until 1975.

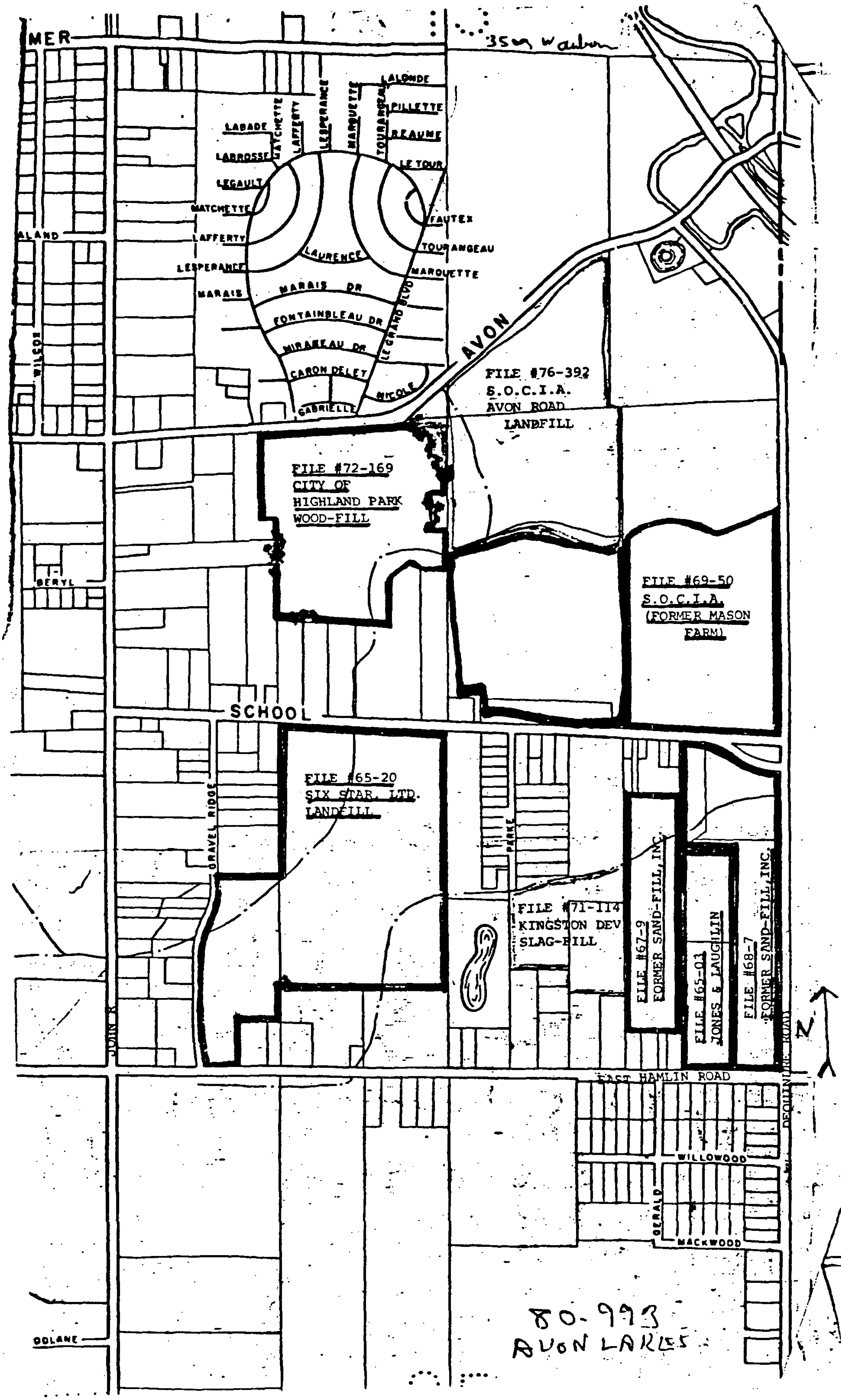
Northeast of the Stan's Landfill is the Southeast Oakland County Incinerator Authority Landfill (S.O.C.I.A.). This area was part of the old Faulkender Gravel Pit prior to its use as a landfill. Due to swampy conditions, an underdrain was installed as shown on the map in Exhibit (b). "This underdrain consists of some 2,500 lineal feet of 15" perforated "Helicor" corrugated metal pipe. The system was installed as a health measure to conduct contaminated waters away from the area." (Johnson and Anderson, 1964). The underdrain has and continues to control the elevation of the ground water table in and around the S.O.C.I.A. Landfill.

The Sandfill, Inc., Landfill property is being used for a sand and gravel mining operation and also for a landfill. Filling is presently going on in the southeast portion of the property. Sand and gravel are being taken from the northern area adjacent to the Ladd Drain. Some dewatering of the sand and gravel is taking place due to the pumpage from the excavation. The pumpage goes into the Ladd Drain at the northeast corner of the property. We do not know how long this operation has been in existence.

East of the Sandfill, Inc., Landfill (E½, SE¼, Section 24) the area has been previously landfilled. The landfills were operated by M.A.L. Enterprises and were used for the disposal of foundary wastes from Jones and Laughlin along with other fill material.

The Hamlin Development Landfill lies just above the flood plain of the Clinton River. We do not have any background information on the operation but can infer that it is of the same nature as the others discussed, i.e., removal of sand and gravel-fill via landfill.

The ground water contamination problem became apparent as a result of the water quality analyses reported on July 22, 1974, by the Department of Natural Resources, Solid Waste Management Division (DNR-SWMD). An increase in the chemical concentrations, e.g., chemical oxygen demand (COD) was noted in the samples from private wells. Subsequent water quality analyses from both private wells and surface water sources have also demonstrated that the ground water system has been contaminated. As a result, the residents on Parke Street



MER
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FAUTEX
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MIRABEAU DR
CARONDELET
NICOLE
GABRIELLE
LE GRAND BLVD
LAND
WILCOX
AVON
FILE #76-392
S.O.C.I.A.
AVON ROAD
LANDFILL
FILE #72-169
CITY OF
HIGHLAND PARK
WOOD-FILL
FILE #69-50
S.O.C.I.A.
(FORMER MASON
FARM)
BERYL
SCHOOL
FILE #65-20
SIX STAR, LTD.
LANDFILL
GRAVEL RIDGE
PARKE
FILE #71-114
KINGSTON DEV
SLAG-FILL
FILE #67-9
FORMER SAND-FILL, INC.
FILE #65-03
JONES & LAUGHLIN
FILE #68-7
FORMER SAND-FILL, INC.
JOHN R
EAST HAMLIN ROAD
DEQUINDRE ROAD
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WILLOWOOD
GERALD
MACKWOOD
DOLANE
80-993
AVON LAKES

are no longer able to use their well water for consumption. Bottled water is being provided for cooking and drinking purposes (personal communication from Mr. T. Work, DNR-SWMD).

Topography

The natural surficial features in the area are the result of glacial processes which occurred during the Wisconsin Glacial Period. The Huron Lobe of the Wisconsin Ice Sheet retreated from the area some 10,000 to 15,000 years ago to the southeast. Note the general southwest-northeast lineation of the contour lines in Sections 13, 14, 23, 24, 25 and 26 of Avon Township. The higher elevation area in Sections 13, 14, 23, and 24 form a part of the Birmingham Moraine. This moraine has been eroded along the course of the Clinton River. As the erosion process was occurring, a delta was being formed southeast of the Moraine. The fan-shaped pattern of the contour lines in the area where Sections 13, 14, 23 and 24 intersects shows this feature quite well (see Exhibit a). Deltaic deposits such as this along with the outwash deposits associated with the Clinton River are the reason for the prevalence of sand and gravel in the area.

The deltaic and outwash materials were deposited over fine grained lacustrine clays. These clays in turn were deposited at a time when the waters of Lake St. Clair and all of the Great Lakes were at a much higher elevation. This accounts for the flat land surface which has a gentle slope to the present shoreline of the Great Lakes.

Surface Drainage

The major drainage-way in the area is the Clinton River. Flowing into the Clinton are the Honeywell and Ladd Drains from the west. Their courses flow through all three of the previous mentioned landfills in Section 24. The absence of other surface drainage is quite reasonable considering the permeable nature of the soils in the area. Precipitation falling on the ground surface will generally be lost back to the atmosphere via evaporation and transpiration, infiltrate and become part of the ground water system, or enter the drains as surface runoff.

The Honeywell Drain owes the major portion of its flow to infiltration of ground water during the periods of high water tables. As the drain flows through Section 24, we suspect that it changes its nature depending on the precipitation pattern. When precipitation is heavy, the ground water system is recharged and flows into the Drain. During dry periods, water in the drain from the upland morainal area will enter the ground water system in Section

24. This process is reasonable considering that the bed of the Honeywell Drain is sandy in areas. Thus, there is a distinct interrelationship between the surface and ground water systems.

Bedrock Geology

The uppermost bedrock formation underlying the study area is the Coldwater Shale. This formation lies beneath approximately 150-190 ft of glacial drift. The Coldwater Formation is comprised of interbedded sandstones and shales and has little value as an aquifer. It is about 65 ft in thickness and is underlain by the Berea Sandstone.

Surficial Geology

The upper most glacial drift is sand and gravel which is approximately 20-30 ft thick. Lacustrine (lake) clays underly the sand and gravel, and average 80-100 ft in thickness. The remainder of the glacial materials vary in nature, and well logs for the area show that some deeper aquifers are present. Some of these deeper aquifers, however, yield poor quality water, e.g., the supply for the S.O.C.I.A. office showed 289 ppm chlorides upon completion (12-2-68).

Hydrogeology

The sand and gravel material overlying the lake clays form a usable water table aquifer in the study area. Most of the domestic wells derive their supply from this aquifer. In order to determine the characteristics of the ground water system, five soil borings and monitor wells were installed. These were in addition to the fifteen (15) monitor wells previously installed by Stan's Landfill and others. The locations are shown on the map in Exhibit (b), and the columnar sections are presented in Exhibit (c).

Water table elevations were determined at each monitoring point as shown on the map in Exhibit (d). These values were contoured to arrive at the water table elevation contour map. This map represents the conditions at the time of measurements. As discussed previously, the ground water system varies with the amount of recharge. Thus, the flow pattern can, and we feel does, change continuously although the basic pattern remains the same.

The dewatering operation at the Sandfill Inc. Landfill will have a temporary effect of lowering the water table in that area. When the operation is complete, the proposed clay dike has been designed to prevent the inflow of ground water. This will again alter the flow pattern somewhat. Another

~~~tificial installation affecting the flow pattern is
e underdrain in the S.O.C.I.A. Landfill. This is a
ermanent feature and will continue to control the ground
ater system in that area as long as it is not plugged.

e arrows on the map in Exhibit (d) indicate the direction
f ground water movement. Generally the flow is to the
ast although the influence of the underdrain system is
pparent. Note the bifurcation of the flow path in the
rea of the Parke Street and School Road intersection. This
ituation plays a large role in the pattern of aquifer con-
amination. Away from the underdrain area, the flow will
gain be to the east towards the Clinton River.

rom the data we can compute the hydraulic gradient and the
elocity. These values will again be valid only for the
onditions at the time of measurement. They will serve,
owever, as indicators of the average conditions.

$$\text{Velocity} = \frac{KI}{7.5\ \text{S.Y.}}$$

Where K = permeability in GPD/ft^2
I = gradient in ft/ft
S.Y. = Specific Yield-fraction

Sand samples were taken during the auger boring, and tested
for permeability in our office using a constant head per-
meameter. Two samples, one each from Borings A and B gave
an average value 130 GPD/sq. ft. The gradient through Parke
Street was taken from the map in Exhibit (d) as 0.007 ft/ft.
~~~

An average specific yield for a sand is 20%.

$$\text{So:} \quad V = \frac{KI}{7.48\ \text{S.Y.}} = \frac{130 \times .007}{7.48 \times .2} = \underline{\underline{0.6\ \text{ft/day}}}$$

The approximate distance from the east edge of the Stan's Landfill to the homes along Parke Street is 500 ft.

$$\frac{500\ \text{ft}}{.6\ \text{ft/day}} = 833\ \text{days or } 2.3\ \text{years}$$

As stated previously, the northeast area of Stan's Landfill began receiving fill in 1972. Adding in the time required to flow the 500 ft indicates that were the Stan's Landfill the source of the contamination, the problem should have become apparent in about mid-1974. This corresponds quite well with the results of the Parke Street well water analyses performed on July 22, 1974. Again, we must point out that these are averages since we would expect more rapid movement during the wet seasons and a decrease in flow during the dry periods. However, since total distance of ground water movement and velocity are also averaged, the computations do serve as valid estimates.

We must also point out that the preceeding discussion assumes that leachate was generated very soon after emplacement of fill material. This situation is entirely possible considering the hydrogeologic conditions. Another possible cause could be

..e fill that was placed in the area between the current ..st property line of Stan's Landfill and Parke Street. ..st likely, both situations are contributing to the problem.

..ilizing the same data we can compute the quantity of water ..owing eastward per horizontal width of aquifer.

Use: $Q = TIL$ Where: Q = flow in GPD

T = Transmissivity in GPD/ft

L = Horizontal width of aquifer

Now: $T = kb$ Where: b = saturated thickness of aquifer

$T = 130 \times 18 = 2358$ GPD/ft

and flow per 100 ft width of aquifer -

$Q = 2358 \times .007 \times 100 = \underline{\underline{1650 \text{ GPD}}}$

..he east property line of the Stan's Landfill is approximately ..,000 ft, so the flow out of that area per day is approximately -

$$Q = \frac{2000 \text{ ft} \times 1650}{100 \text{ ft}} \cong \underline{\underline{33,000 \text{ GPD}}}$$

..onsidering the hydrologic budget this figure represents ..echarge of:

Area $\cong 2,000 \times 2,000 = 4 \times 10^6$ sq. ft.

W (recharge) $= \dfrac{33,000}{4,000,000} = 8.25 \times 10^{-3}$ GPD/ft^2

and 8.25×10^{-3} GPD/ft$^2 \cong 4.8$ inches of precipitation per year.

The average amount of precipitation falling on the area per year is about 31 inches. So the 4.8 inches of recharge represents

$$\frac{4.8}{31} = \underline{\underline{15\%}} \text{ of total precipitation}$$

Again, this value is quite reasonable for the average recharge to a water table aquifer.

Contamination

Numerous ground water and surface water sources were sampled for chemical analyses. A total of 58 samples were collected: during the study, 28 homes, 13 surface water sites, and 17 monitor wells. Prior to this study, a considerable number of samples had been taken and analyzed by various State Agencies. All of the available data has been tabulated and is presented in Appendix 2. The sampling points for this study are shown on the maps in Exhibits (a) and (d). As an aid in visualizing the extent of the contamination, we have prepared a map showing the concentrations of chemical oxygen demand (COD) chloride, nitrate and total dissolved solids (TDS) at the various sampling points. This map is presented as Exhibit (e).

At the time of sampling, representatives of our firm surveyed the private well owners as to their well construction. The majority reported their wells were in the upper sand aquifer, and were small diameter (2-inches). We should also emphasize at this time that the homes in the area have on-site (septic) sewage systems. These septic systems are in the same sand aquifer as the private wells. Such a situation is conducive to contamination of one's own well. We feel this is occurring to some degree in the homes along Gravel Ridge Road, particularly house numbers 1480, 1521 and 1740. House number 1031 Hamlin Road also exhibits this characteristic.

The cause of ground water contamination found in the School Road-Parke Street area can be seen quite easily by comparing the maps in Exhibits (d and e). Note how the concentration pattern generally follows the ground water flow pattern. Leachate from the Stan's Landfill is entering the ground water system and moving with it to the east. The splitting of the flow pattern results in the lower chemical concentrations in the vicinity of house numbers 1650 and 1670 School Road. We cannot determine the exact configuration of the leachate plume nor where the leachate is entering the ground water system. Most likely there is a considerable area of the landfill contributing leachate to the ground water.

Analyses of the surface water samples indicate that other ground water contamination has occurred in the study area. Actually, all of the sampling points showed some indication of contamination. This situation is indeed unfortunate but not to be unexpected considering the prevalent landfill activity that has been and is going on in the area. Combine this with the septic systems, roadway contaminants, and small industry along Hamlin Road, and the potential sources for contaminants covers most of the study area. Since there is no protective layer (clay) overlying the sand and gravel aquifer, all of the contaminants have direct access to the ground water system and to the wells that withdraw the water.

Certain portions of the aquifer do not appear to have suffered extensive contamination at this time. This is a temporary situation, however, since with time, there exists the possibility for significant contamination of the entire aquifer between Gravel Ridge Road and the Clinton River. The only way to prevent this from happening is to capture and treat the contaminated ground water. It would be almost impossible to excavate and/or eliminate all the present and potential future sources of contamination.

Capturing the ground water, while technically possible, does not appear economically feasible. Numerous wells, underdrains, and/or ditches would be required around the sources of contamination. While such a system could control the flow, it would also lower the water table in the area to the point that the aquifer would have little value as a source of supply.

Thus, there appears to be little hope for renovating the aquifer for use as a source of domestic water supply. Whether or not the contamination will be allowed to continue is a matter for the proper State Agencies to evaluate.

Conclusions

1.) The majority of the domestic wells in the area derive their supply from a water table sand and gravel aquifer which is areally extensive.

2.) Numerous sanitary landfills have been and are being placed within the aquifer.

3.) The direction of ground water movement is generally to the east except where altered by artificial dewatering systems.

4.) The water table aquifer has been seriously degraded due to contamination from a number of sources:

   a. presently active landfills
   b. completed landfills
   c. domestic septic systems
   d. light industry

5.) The domestic wells along Parke Street and School Road have been contaminated mainly by leachate from the Stan's Trucking Landfill.

6.) Contamination of the water table aquifer by all sources will continue for a considerable time into the future even if the sources are eliminated.

7.) Capture and/or containment of the ground water would severely decrease the quantity of water available to domestic wells.

8.) Leaving the conditions as they are presently will eventually result in contamination of the entire aquifer eastward to the Clinton River.

We hope the preceeding report will help you in understanding the ground water contamination problem in Avon Township, Oakland County, Michigan. Should there be any questions concerning the report of the study in general, we will be happy to respond.

Respectfully submitted,

KECK CONSULTING SERVICES, INC.

Robert C. Minning, M.S.,
Professional Hydrogeologist

RCM:kw

APPENDIX I

Auger Boring Logs

KECK CONSULTING SERVICES, INC.
"Ground Water Specialists"
4903 Dawn Avenue • East Lansing, Michigan 48823 • (517) 332-8623

SOIL BORING DATA

JOB NUMBER 0428 DATE January 6, 1976
OWNER State of Michigan
LOCATION: State Michigan County Oakland Twp. Avon
Section 24 T. ____ N.S.; R. ____ E.W. ____

MINERAL WELL PERMIT NUMBER: 259-752-163

AUGER: 4-inch ☐ 6-inch ☒ Profile ☒ Split-spoon ☐

PLUGGING METHOD:
☒ Natural Materials
☐ Bentonite
☐ Cement

Geologist G. Henry & R. Hilty Field Ass't ____

BORING NUMBER B1- OW A TOTAL DEPTH 35 ft S.W.L.(BGL) 13.02 ft

Sample Number	From __ to __ Feet	Lithologic Description
	0 - 1	Topsoil, loamy
	1 - 4.5	Sand, coarse and gravel, brown
	4.5 - 7.5	Sand, medium, brown
	7.5 - 9	Sand; fine and silt, brown
	9 - 31	Sand; medium, well-sorted, light brown-gray
	31 - 35	Clay; silty, gray

Piezometer: ☒ *Screen 36" Pipe 21 ft Total Depth (BGL) ____
*All piezometers equipped with Johnson Stainless Steel "..
..nts, 2-inch diameter 36 ...

NUMBER 0428 DATE January 6, 1976 PAGE 2

ING NUMBER B2 - OW B TOTAL DEPTH 35 ft S.W.L.(BGL) 12.51

mple mber	From to Feet	Lithologic Description
	0 - 1	Topsoil, loamy
	1 - 13	Sand; medium-coarse and gravel, brown
	13 - 32	Sand; medium-fine, light brown
	32 - 35	Clay; silty, gray

zometer: ☒ Screen 36" Pipe 21' Total Depth (BGL) ______

ING NUMBER B3 - OW C TOTAL DEPTH 35 ft S.W.L(BGL) 15.52 ft

mple mber	From to Feet	Lithologic Description
	0 - 1	Topsoil, loamy
	1 - 9.5	Sand; coarse and gravel, brown
	9.5 - 29	Sand; medium, light brown-gray
	29 - 35	Clay; silty, gray

ezometer: ☒ Screen 36" Pipe 21' Total Depth (BGL) ______

ING NUMBER B4 - OW D TOTAL DEPTH 45 ft S.W.L.(BGL) 15.73 ft

mple mber	From to Feet	Lithologic Description
	0 - 3	Sand; coarse and gravel brown
	3 - 32	Sand; medium-fine, light brown-gray
	32 - 34	Clay; silty, gray
	34 - 38	Sand; very clayey, w/clay strips
	38 - 45	Clay; silty, gray

ezometer: ☒ Screen 36" Pipe 21' Total Depth (BGL) ______

NUMBER 0428 DATE January 7, 1976 PAGE 3

RING NUMBER B5 - OW E TOTAL DEPTH 45 ft S.W.L.(BGL) 25.31

Sample Number	From to Feet	Lithologic Description
	0 - 1	Topsoil, loamy
	1 - 16	Sand; coarse and gravel, brown
	16 - 38	Sand; medium, light brown
	38 - 45	Clay; silty, gray

Piezometer: ☒ Screen 36" Pipe 31' Total Depth (BGL)

RING NUMBER B6 TOTAL DEPTH 30 ft S.W.L(BGL) 3 ft

Sample Number	From to Feet	Lithologic Description
	0 - 6	Sand; coarse, w/gravel, brown, saturated
		below 3 ft
	6 - 30	Clay; gravelly, blue-gray

Piezometer: ☐ Screen Pipe Total Depth (BGL)

RING NUMBER TOTAL DEPTH S.W.L.(BGL)

Sample Number	From to Feet	Lithologic Description

Piezometer: ☐ Screen Pipe Total Depth (BGL)